

A Preliminary Survey of the Freshwater Mussels of the Saugeen River Watershed, Ontario.

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ABSTRACT

A survey of the freshwater mussels (Unionidae) of the Saugeen River watershed of southwestern Ontario was undertaken by Fisheries and Oceans Canada staff in September 2006. Eight sites were sampled across the watershed including sites in all 5 sub-basins and the main channel. In total, 1064, mussels were collected during this survey representing 8 species. When combined with results from limited historic and opportunistic sampling in the watershed these results bring the total number of species recorded for the watershed to 11. The dominant species in the Saugeen River was *Elliptio dilatata* occurring at 85% of sites and representing 67% of all mussels encountered. Only one mussel Species at Risk, *Villosa iris*, was detected during the survey. Although widespread (occurring at 71% of sites) this species was numerically rare representing less than 5% of all mussels.

RÉSUMÉ

En septembre 2006, Pêches et Océans Canada a étudié les moules d'eau douce (Unionidae) du bassin hydrographique de la rivière Saugeen, dans le sud-ouest de l'Ontario. On a échantillonné huit sites dans tout le bassin hydrographique, y compris des sites dans les cinq sous-bassins et dans le chenal principal. Au total, on a relevé 1 064 moules, représentant huit espèces. Lorsqu'on intègre les résultats d'échantillonnages antérieurs et fortuits faits dans le bassin hydrographique aux résultats de cette étude, le total des espèces consignées monte à onze. L'espèce dominante dans la rivière Saugeen était *Elliptio dilatata*, présente dans 85 % des sites et représentant 67 % de toutes les moules observées. Au cours de l'étude, on a décelé seulement une espèce de moule en péril, le *Villosa iris*. Bien que cette espèce soit répandue (présente dans 71 % des sites), elle est rare quant au nombre d'individus, ne représentant que moins de 5 % des moules, toutes espèces confondues.

1.0 INTRODUCTION

The Saugeen River watershed is located in southwestern Ontario (Figure 1). The watershed consists of the main river and 5 major branches (North Saugeen R., Rocky Saugeen R., Beatty Saugeen R., South Saugeen R. and Teeswater R.) and drains 4,052km² making it the third largest watershed in southern Ontario (Judd, 2000). With its headwaters in Osprey Township, the river's numerous branches flow through largely agricultural lands eventually terminating in Lake Huron at the town of Southampton. The river is divided geologically into two major regions: the North Saugeen containing course substrate, a product of glacier presence, and the Lower Saugeen containing silts and clays (Judd, 2000).

Little is known of the historical unionid fauna of the Saugeen watershed as Fisheries and Oceans Canada's Lower Great Lakes Unionid Database contains only 34 records for the watershed. Although the earliest record dates back to 1929 there are no records between 1929 and 1968 and only 5 sites have been formally surveyed for freshwater mussels (Morris and DiMaio 1998-1999). Even at these five sites, which account for 29 of the 34 historical records for the watershed, the relative effort was low (1 person-hour of searching). Despite this paucity of information there is reason to believe that the mussel fauna of the Saugeen River may contain some significant species. Morris and DiMaio (1998-1999) reported finding specimens of the federally Endangered Rainbow (*Villosa iris*) near Paisley in 1993 and biologists from Environment Canada collected a specimen of Fawnsfoot (*Truncilla donaciformis*), a candidate species for listing by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), in the Teeswater River well outside its previously known distribution in 2005. In addition, the federally Endangered Wavyrayed Lampmussel (*Lampsilis fasciola*) has been recorded from the Maitland R., Ausable R., Sydenham R. and Thames R. watersheds representing 4 of the 5 large watersheds immediately south of the Saugeen River (Morris 2006). For this reason we set out in 2006 to undertake a survey of the Saugeen River watershed using the standard methodology established by Environment Canada and employed elsewhere in southern Ontario (Metcalf-Smith *et al.* 2000) and specifically targeting areas where species at risk might be found.

2.0 METHODS

Eight sites in the Saugeen River watershed were visually surveyed using the intensive timed-search technique of Metcalfe-Smith *et al.* (2000) (Figure 2). At each site the substrate was surveyed to the maximum wading depth by a three person team moving upstream, perpendicular to the river bank for a total of 4.5 person-hours (p-h) per site. Only site SG3 was surveyed for a period of less than 4.5 p-h as the search was terminated after 3 p-h when no live animals or shells were detected. During the surveys all live animals were removed from the substrate and placed in a mesh diver's bag. At the end of the sampling period, mussels from all collectors were combined, identified, sexed if possible, measured for maximum length and returned to the river.

In addition to the biological data on the mussel community several physical and environmental variables were also recorded at each site. These data are not meant to address issues relating to species microhabitat preferences but rather to provide a general description of the site and assist future researchers in locating the exact site should a revisitation be required. These variables include substrate composition, water clarity, length of reach, mean stream depth and width. Details of site locations, effort and collectors are presented in Table 1 while Figure 2 identifies the location of each site.

3.0 RESULTS

3.1 ABIOTIC FACTORS

Table 2 provides a summary of the physical data for the eight sample sites. In general, the Saugeen River watershed is characterized by large areas of very coarse substrate. Five of the eight sites surveyed during this project were dominated by rubble material (< 25 cm diameter), although all sites contained ample amount of gravel materials (6 – 25 cm diameter). It can also be seen from Table 2 that the Saugeen River is generally a low turbidity system as water clarity was always high providing visibility through the entire water column.

3.2 FRESHWATER MUSSEL COMMUNITY

In total, 1064 animals representing 8 species were collected during this survey (Table 3). Total abundance was highly variable across sites (Figure 3) ranging from a low of 10 animals at SG6 on the Rocky Saugeen R. (excluding SG3 where no animals

were found) to a high of 408 animals on the Teeswater River (SG2) (Table 3). Overall species richness is relatively low for a watershed of this size in southwestern Ontario with only 8 species detected (Table 3) but this does compare well with the adjacent Maitland River (9 species; McGoldrick and Metcalfe-Smith 2004). Similar to patterns in abundance, richness was highly variable across sites ranging from a low of 1 at SG5 where only *Elliptio dilatata* was recorded and SG1 where only *Villosa iris* was found to a high of 7 at SG2 where every species except *Alasmidonta viridis* was recorded. Patterns of species richness closely followed patterns of abundance with the highest richness observed in the main branch of the Saugeen and the Teeswater River. The dominant species in the watershed is *E. dilatata* which was found at 85% of the sites and represented two thirds of all animals collected during this study. By contrast, *Alasmidonta marginata* and the federally Endangered *Villosa iris* were both widespread (found at 71% of sites) but only occurred in low numbers (each approximately 5% of all mussels) (Table 3).

3.2.1 *Alasmidonta marginata* (Elktoe)

As discussed above *A. marginata* was the second most abundant species in terms of frequency of occurrence (Table 3) however it was only the fourth most abundant species when comparing relative abundance (56 specimens). This species was found in all sub-basins except the South and North Saugeen rivers (Figure 6) but had its highest abundance in the middle portions of the watershed in the Beatty Saugeen R. and the main branch in Hanover. The length frequency distribution (Figure 7) for *A. marginata* indicates a good range of size classes with one exceptionally good cohort and ample evidence of recent reproduction and recruitment.

3.2.2 *Alasmidonta viridis* (Slippershell)

Only 8 specimens of *A. viridis* were found during the study making it the second rarest species (Table 3). It was only found at two sites (SG4 and SG7) which correspond to the two sites where *A. marginata* was also most abundant. Although specimens of this species are very small and difficult to detect, the clear, and often shallow, water of the Saugeen River makes their detection here much easier than it would be in many other Ontario watersheds. It is not possible to evaluate the size distribution or reproduction/recruitment for this species with such a small sample size.

3.2.3 *Elliptio dilatata* (Spike)

Elliptio dilatata was widespread and abundant occurring at all but two sites and representing the single largest component of the mussel community at all sites where it was found with the exception of SG6 (Rocky Saugeen R.) (Table 3). This species was most abundant in the Teeswater River and the main branch of the Saugeen R. (Figure 9). The 717 specimens collected provide abundant evidence of recent reproduction and recruitment however there appears to be a slight overrepresentation of large older individuals indicating the possibility of some recent reproductive declines (Figure 10).

3.2.4 *Lampsilis cardium* (Plain Pocketbook)

Lampsilis cardium was only found at two sites (Figure 11) corresponding to the two sites with the greatest overall species richness and abundance (Table 3, Figure 4 and 5). At these two sites, particularly SG2, they were quite abundant (96 individuals). Figure 12 shows the size frequency distributions for both males and females indicating evidence of multiple size classes in both sexes and highlighting the difference in mean sizes of males (103mm) and females (88mm). Males outnumbered females by a ratio of 2.93:1.

3.2.5 *Lampsilis siliquoidea* (Fatmucket)

Lampsilis siliquoidea are a rare component of the mussel community in the Saugeen River and were also only found at the two sites of highest total mussel abundance and richness (Figure 13). They were never abundant (Table 3) representing only slightly more than 1% of the total mussel community (Table 3). It is not possible to evaluate reproduction for this species because of the small sample sizes for the two sexes (10 males, 4 females). The sex ratio for *L. siliquoidea* was similar to the ratio for *L. cardium* at 2.5:1 in favour of males.

3.2.6 *Lasmigona costata* (Flutedshell)

Lasmigona costata were only detected at one site (SG2) (Figure 14) however at this site they were the second most abundant species behind only *E. dilatata*. The size frequency distribution for this species (Figure 15) provides evidence of recent reproduction and recruitment indicative of a healthy population.

3.2.7 *Strophitus undulatus* (Creeper)

Strophitus undulatus was the rarest species encountered during this survey occurring at only 2 sites and representing less than 1% of the total mussel community (2 individuals)(Table 3). As with *L. cardium* and *L. siliquoidea*, this species was only found at the two sites with greatest abundance and richness (Figure 16). With only two individuals detected it is not possible to evaluate reproduction.

3.2.8 *Villosa iris* (Rainbow)

The federally Endangered *Villosa iris* was widely distributed within the watershed occurring at 5 sites but numerically rare and only represented by large numbers at SG1 (Figure 17) where it was the only species found. This site also contained numerous spent, fresh and weathered shells of *V. iris*. Interestingly, the site was characterized by large numbers of crayfish as this species is known to possess a lure that mimics a small crayfish in order to attract its glochidial hosts (COSEWIC 2006). Although the sample size is not large the size frequency distribution indicates multiple size classes and evidence of recent reproduction (Figure 18).

4.0 DISCUSSION

The mussel community of the Saugeen River appears to be healthy. For all species for which sufficient numbers were found there is evidence of recent reproduction and recruitment suggesting that current distributions can likely be maintained in the absence of a catastrophic event. With the limited amount of historical data available (Table 4) it is not possible to fully evaluate trends over any meaningful period of time however it is possible to compare the results of Morris and DiMaio's (1998-1999) surveys in 1993 and 1994 with the work completed in 2006 as well as the scattered records available from other sources.

The 2006 and 1993-1994 surveys each reported a total of 8 species and combining these efforts gives a cumulative total of 10 species. The two species that Morris and DiMaio (1998-1999) (Table 4) collected from the river in 1993-1994 that were not found in 2006 were *L. compressa* and *P. grandis*. As both of these species are characteristic of smaller streams than those surveyed in 2006 and both were collected in small numbers in 1993-1994 it is likely that both still persist but were simply not detected because of the nature and location of the sampling in 2006. One additional species,

Truncilla donaciformis, was not collected in either of the targeted surveys in 1993-1994 or 2006 but was collected alive from a tributary (Muskrat Creek) to the Teeswater River in 2005. The collection of *T. donaciformis* from this small headwater stream is particularly unusual for several of reasons. First, the host species is believed to be the freshwater drum (Surber 1913) a species which would not likely be found well up in the headwater regions (Scott and Crossman 1998). A minimum of 6 dams or barriers stand between the mouth of the river in Southampton and the site where *T. donaciformis* was collected (pers. comm. M. Nichols, Saugeen Valley Conservation Authority) making natural passage unlikely. Second, this record represents the only record, historic or current, for this species from the Canadian waters of the Lake Huron drainage. Finally, no other indications of this species' presence have ever been found in the watershed despite nearly 40 hours of directed searching over 13 sites. It is not clear at this time whether this record represents a natural occurrence or an individual possibly deposited through human activity (e.g., direct release, release of infected host). Nonetheless adding this species to the count gives a total of 11 species having been recorded from the watershed over the last 87 years.

The nearest watershed to the Saugeen where a complete mussel census has occurred is the Maitland watershed immediately south of the Saugeen River. In the Maitland River, McGoldrick and Metcalfe-Smith (2004) reported a total of 9 species including 8 species found in the Saugeen (*A. marginata*, *A. viridis*, *L. cardium*, *L. siliquioidea*, *L. costata*, *P. grandis*, *S. undulatus* and *V. iris*) and one that was not (the Endangered *Lampsilis fasciola*). Absent from the Maitland River but present in the Saugeen River were *E. dilatata*, *L. compressa* and *T. donaciformis*. It is interesting that *E. dilatata* represents the most abundant and widespread species in the Saugeen River but was not found in the Maitland while *L. costata* was the most abundant and widespread species in the Maitland River but was only found at one site in the Saugeen River during this survey.

Despite its close proximity to the Maitland River which supports a significant population of the Endangered *L. fasciola* no evidence was found during the present survey, or during any of the previous work, to indicate that this species has ever occurred in the Saugeen River. Despite the fact that its host, the smallmouth bass, can be found in the river (Mandrak and Crossman 1992) and there is ample suitable habitat as defined by Morris (2006), *L. fasciola* does not appear to occur in the Saugeen River. The reason for its absence is not clear at this time but deserves further investigation.

The survey outlined here represents the most comprehensive survey of the freshwater mussel fauna of the Saugeen River ever conducted. However, with a watershed so large and a drainage so complex (5 major sub-basins) significantly more effort is required before we can conclusively claim a complete understanding of the freshwater mussels of the Saugeen River.

5.0 Acknowledgements

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Table 1. Site descriptions, collectors and effort expended for all sites surveyed in 2006.

Site Number	Date	Latitude	Longitude	Waterbody	Local Description	Effort (person-hours)	Collectors
SG1	25/09/06	43.99788	-81.24379	Teeswater River	upstream of Teeswater	4.5	Morris, Granados, Edwards
SG2	25/09/06	44.135	-81.30567	Teeswater River	near Chepstow	4.5	Morris, Granados, Edwards
SG3	26/09/06	44.08282	-80.99017	South Saugeen River	First bridge east of Neustadt, Grey Road #9	3.0	Morris, Granados, Edwards
SG4	26/09/06	44.12287	-80.95862	Beatty Saugeen River	Grey Road 33 near Neustadt	4.5	Morris, Granados, Edwards
SG5	26/09/06	44.32552	-80.9744	North Saugeen River	Concession #8, Mooresburg	4.5	Morris, Granados, Edwards
SG6	26/09/06	44.1799	-80.93921	Rocky Saugeen River	Concession #4, south of Lamlesh	4.5	Morris, Granados, Edwards
SG7	27/09/06	44.15321	-81.03264	Saugeen River	In Hanover, canoe access point #3	4.5	Morris, Granados, Edwards
SG8	27/09/06	44.22359	-81.16612	Saugeen River	West of Elmwood, canoe access point #4	4.5	Morris, Granados, Edwards

Table 2. Physical characteristics of the sites surveyed in the Saugeen River watershed in 2006.

Site	Substrate (%)					Water clarity (m)	Site length (m)	Mean width (m)	Mean depth searched (m)	Stream morphology (%)		
	Boulder (> 25 cm)	Rubble (6 – 25 cm)	Gravel (2 – 5 cm)	Sand (< 2 cm)	Other					Riffle	Run	Pool
SG1	-	80	20	-	-	1.0	181	11	0.4	33	34	33
SG2	-	60	20	20	-	1.0	35	16	0.7	-	100	1
SG3	-	90	5	-	5	1.0	171	9	0.5	30	70	-
SG4	10	70	20	-	-	1.5	260	12	0.3	10	80	10
SG5	-	40	60	-	-	1.5	473	11	0.4	20	80	-
SG6	-	80	10	-	10	2.0	380	22	1.0	10	90	-
SG7	-	20	80	-	-	1.5	312	24	0.5	20	80	-
SG8	-	10	85	-	5	1.0	192	39	0.7	10	90	-

Table 3. Numbers of live specimens of each species collected at each of the 8 sites surveyed in the Saugeen River watershed in 2006.

Common Name	Species	SG1	SG2	SG3	SG4	SG5	SG6	SG7	SG8	Total Abundance	Relative Abundance (%)	Frequency of Occurrence (%)
Elktoe	<i>Alasmidonta marginata</i>	-	6	-	23	-	6	19	2	56	5.26	71.4
Slippershell	<i>Alasmidonta viridis</i>	-	-	-	2	-	-	6	-	8	0.75	28.6
Spike	<i>Elliptio dilatata</i>	-	186	-	136	50	4	69	272	717	67.39	85.7
Plain Pocketbook	<i>Lampsilis cardium</i>	-	96	-	-	-	-	-	9	105	9.87	28.6
Fatmucket	<i>Lampsilis siliquoidea</i>	-	3	-	-	-	-	-	11	14	1.32	28.6
Flutedshell	<i>Lasmigona costata</i>	-	111	-	-	-	-	-	-	111	10.43	14.3
Creeper	<i>Strophitus undulatus</i>	-	1	-	-	-	-	-	1	2	0.19	28.6
Rainbow	<i>Villosa iris</i>	35	5	-	1	-	-	2	8	51	4.79	71.4
	Count	35	408	0	162	50	10	96	303	1064		
	Diversity	1	7	0	4	1	2	4	6	8		

Table 4. Comparison of current and historical mussel sampling in the Saugeen River watershed (* = present; - = not recorded).

Species	2006	Morris and Di Maio 1993-1994 ^a	Other
<i>Alasmidonta marginata</i>	*	*	-
<i>Alasmidonta viridis</i>	*	-	2005 ^b
<i>Elliptio dilatata</i>	*	*	1929 ^c
<i>Lampsilis cardium</i>	*	-	1968 ^d
<i>Lampsilis siliquoidea</i>	*	*	-
<i>Lasmigona compressa</i>	-	*	-
<i>Lasmigona costata</i>	*	*	-
<i>Pyganodon grandis</i>	-	*	-
<i>Strophitus undulatus</i>	*	*	-
<i>Truncilla donaciformis</i>	-	-	2005 ^e
<i>Villoperca iris</i>	*	*	1998 ^f

^a Morris and DiMaio 1998-1999.

^b D. McGoldrick, Environment Canada (weathered valve).

^c R. Cain, Michigan Museum of Zoology collection (unknown).

^d I. M. Smith, Royal Ontario Museum collection (fresh shell).

^e D. Halliwell, B. Upsdell and M. Benner, Environment Canada (live).

^f F. Schueler and J. Schueler, Bishops Mills Natural History Centre (live).

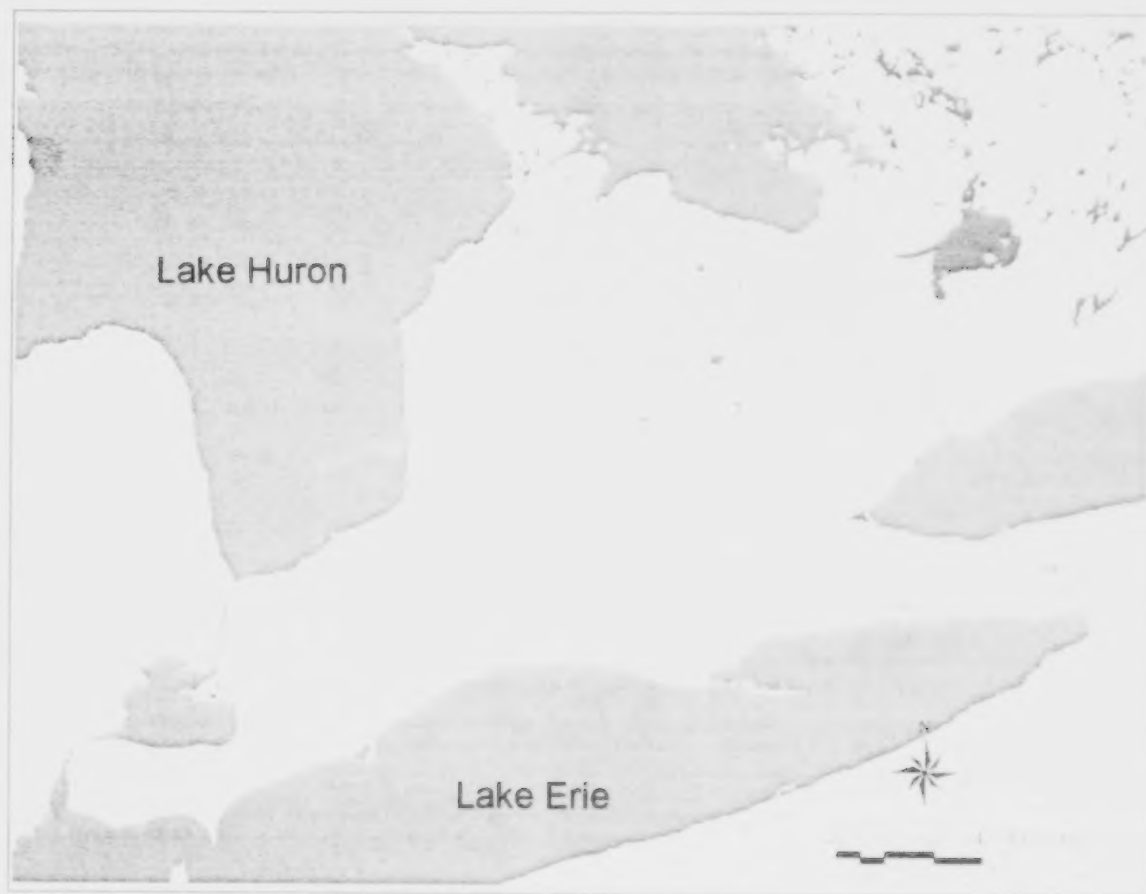


Figure 1. Location of the Saugeen River watershed.

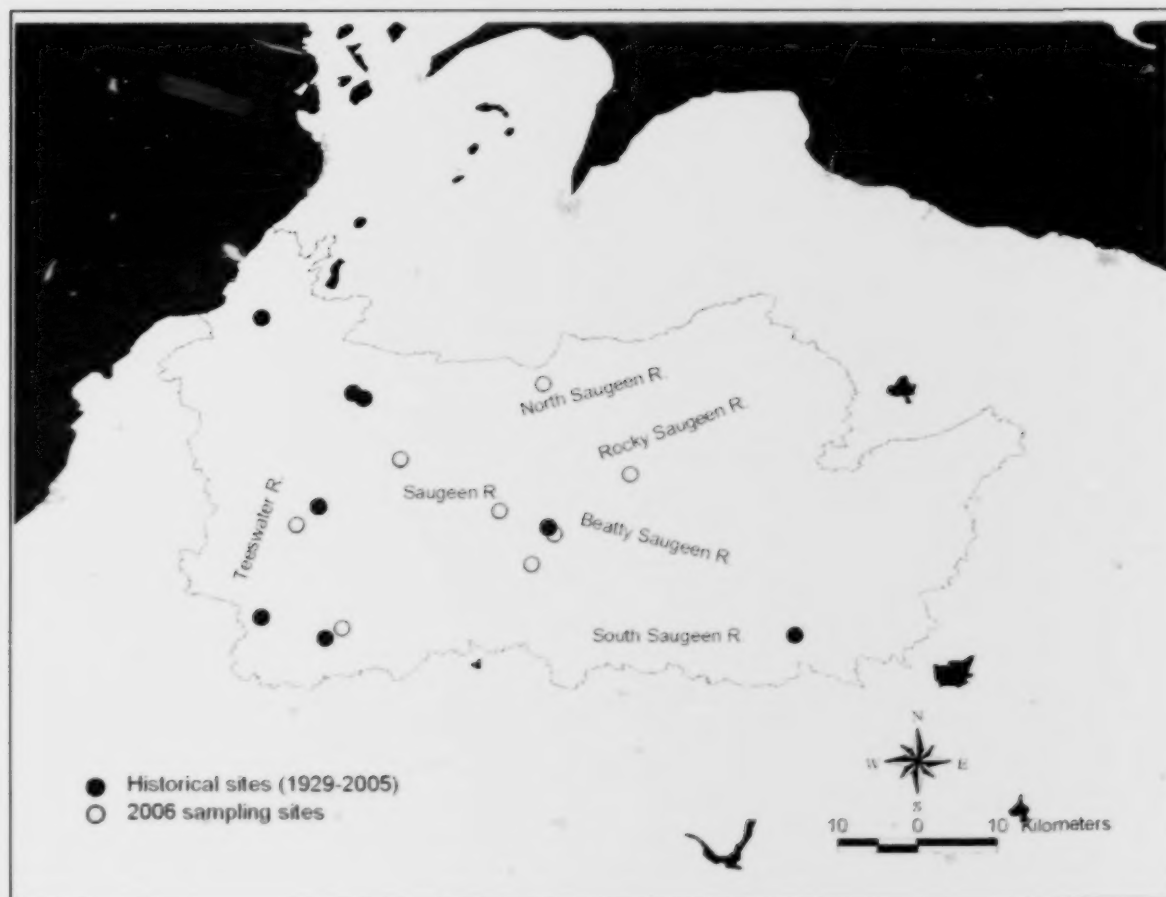


Figure 2. Location of all current and historical mussel sampling sites within the Saugeen River watershed.



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Figure 3. Location of sampling sites from the 2006 mussel survey.



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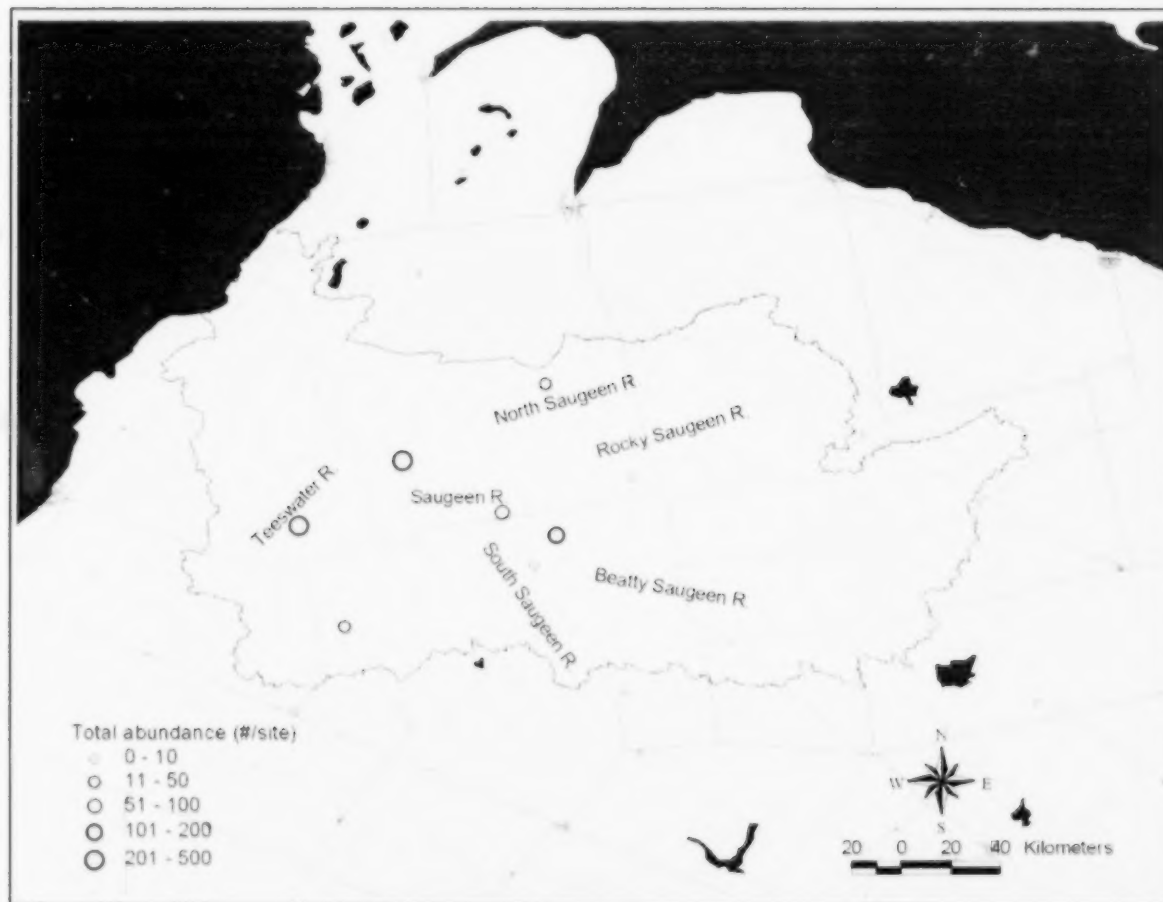


Figure 4. Total unionid abundance at the 2006 sample sites.



Figure 4. Total unionid abundance at the 2006 sample sites.

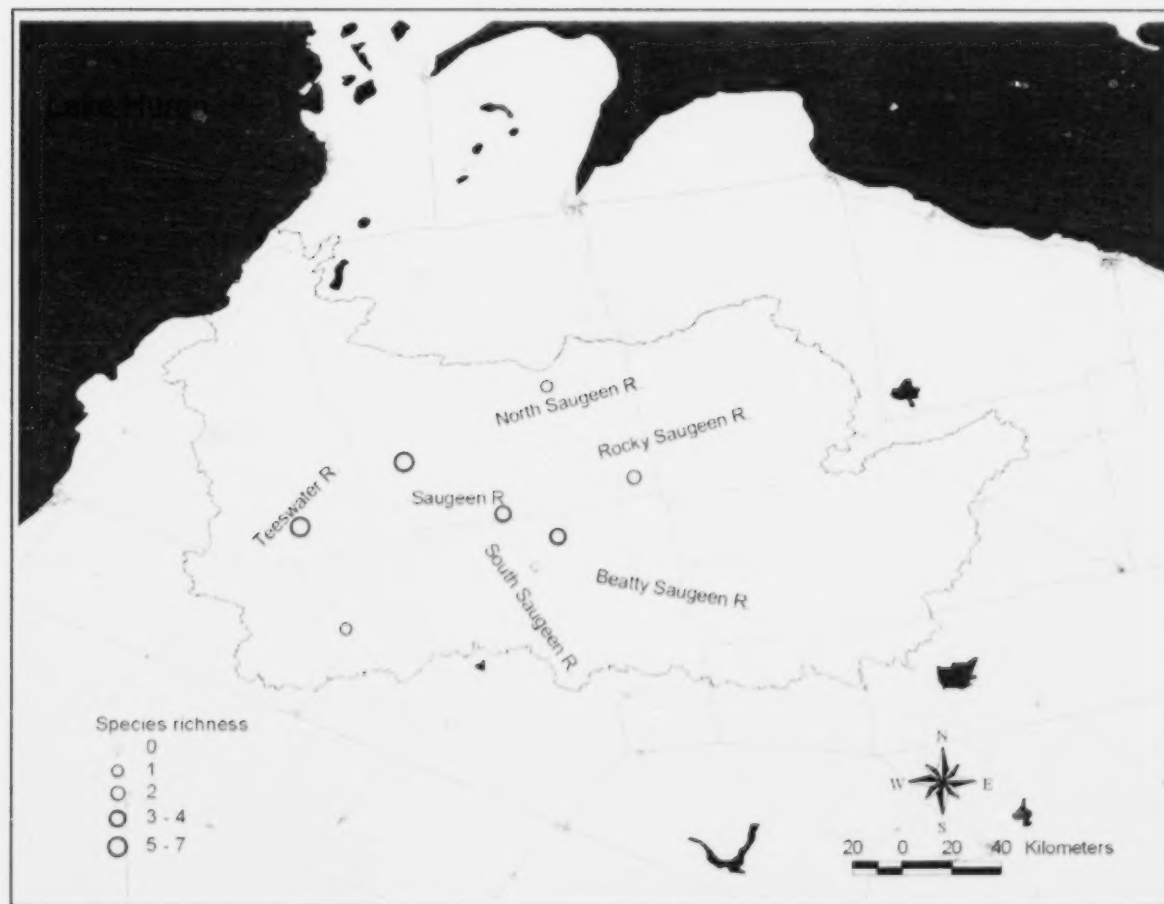


Figure 5. Total species richness (live records) for the 2006 survey sites.



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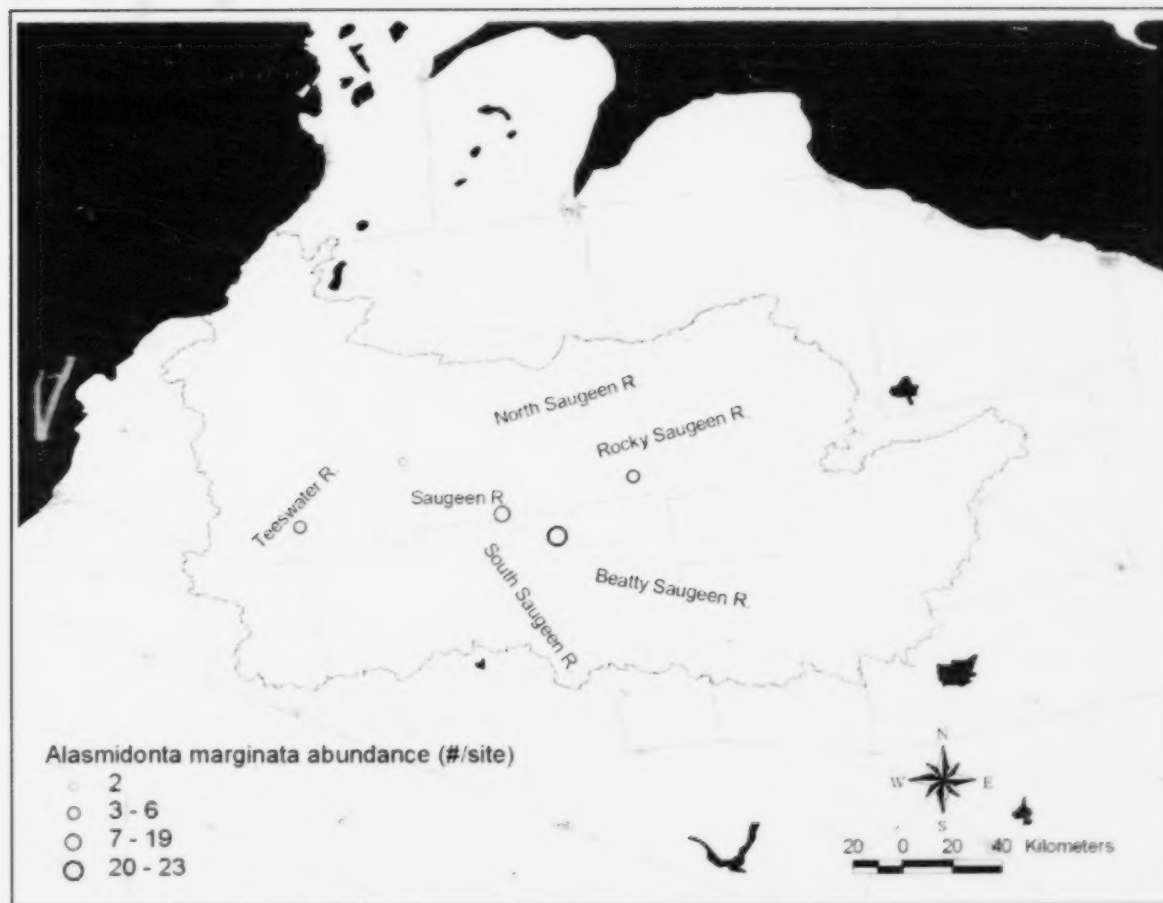


Figure 6. Total abundance and distribution of *Alasmidonta marginata* at all sites sampled in 2006.



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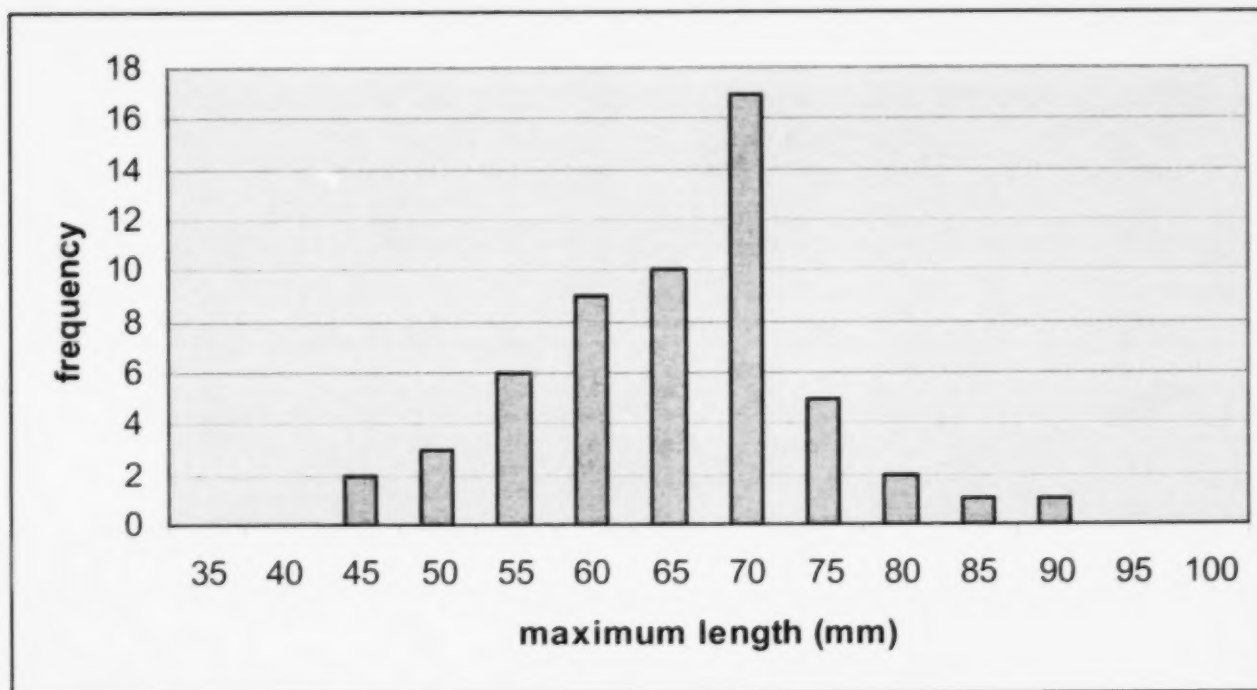


Figure 7. Length frequency distribution for the 56 *A. marginata* collected in 2006.

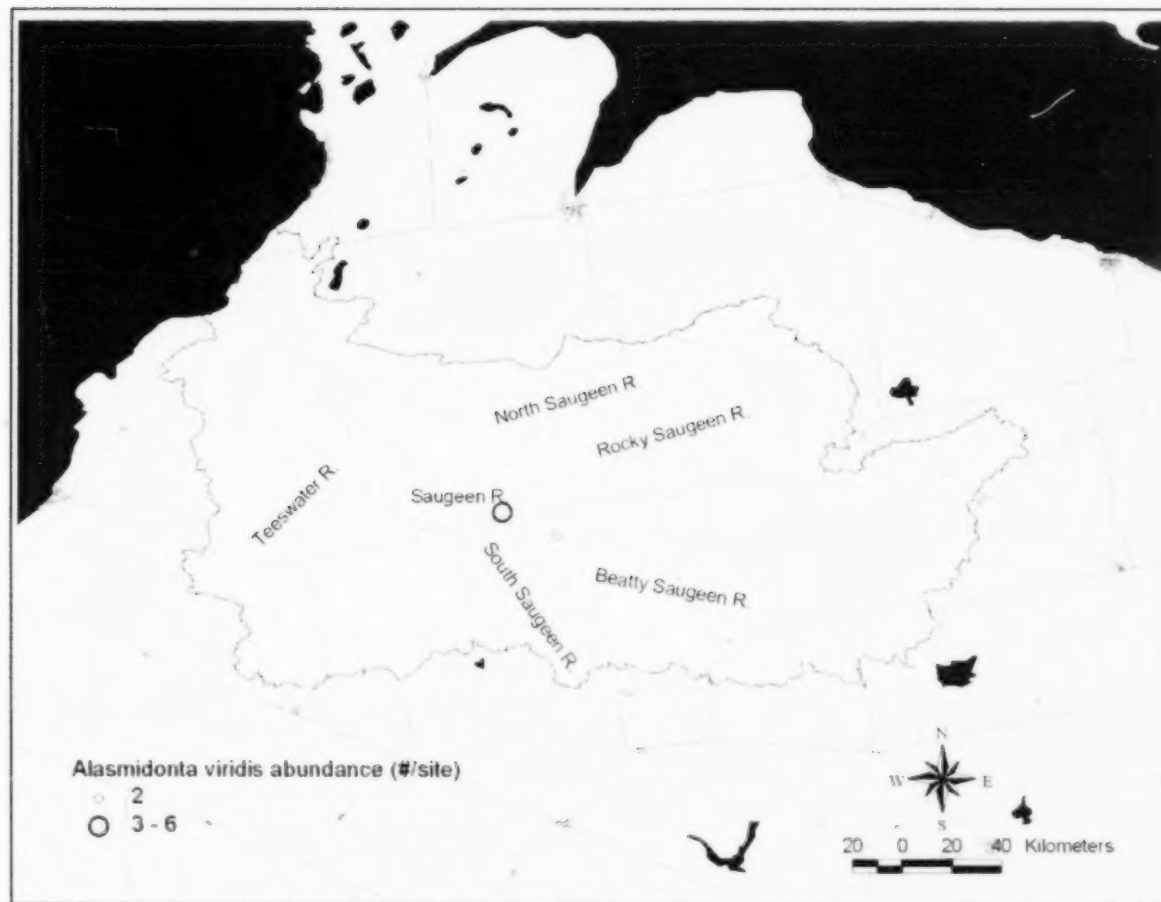


Figure 8. Total abundance and distribution of *A. viridis* at all sites sampled in 2006.



Figure 8. Total abundance and distribution of *A. viridis* at all sites sampled in 2006.

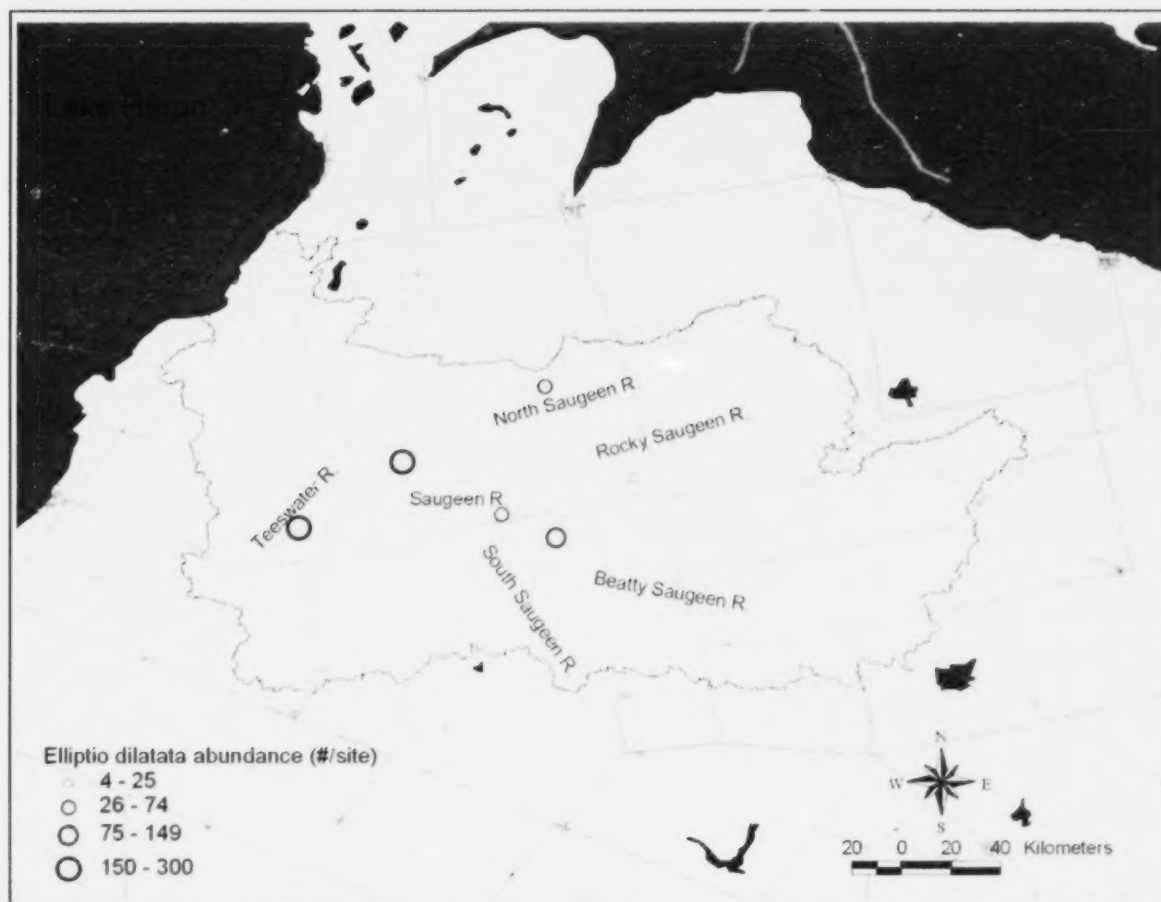


Figure 9. Total abundance and distribution of *Elliptio dilatata* collected during 2006.



Figure 9. Total abundance and distribution of *Elapto dilatata* collected during 2006

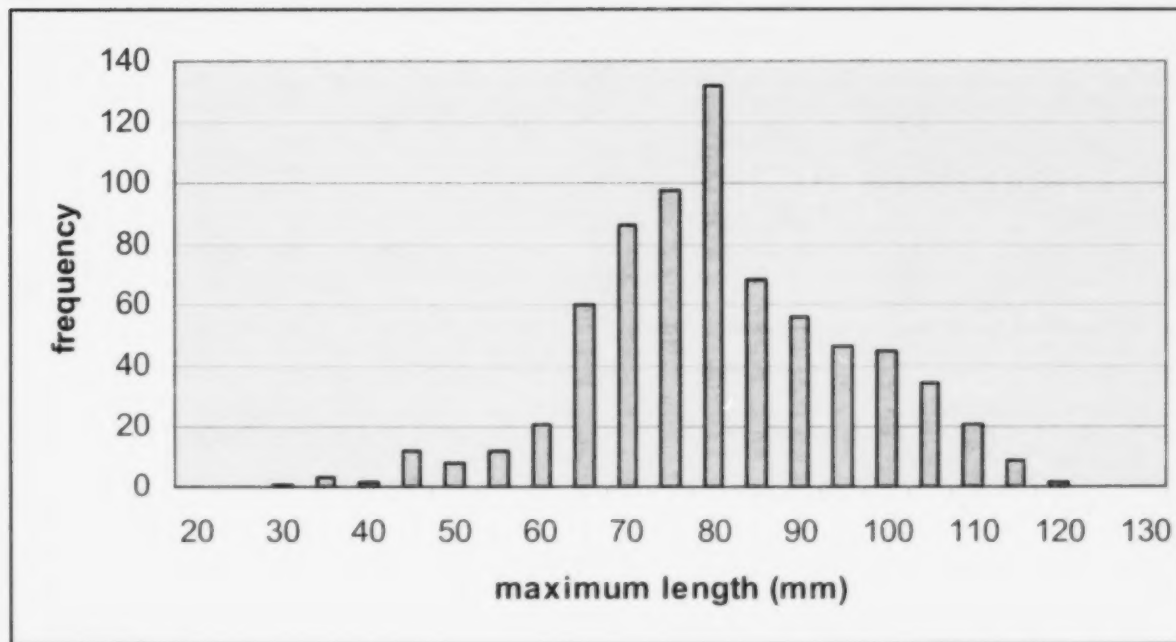


Figure 10. Length frequency distribution for the 717 *E. dilatata* collected in 2006.

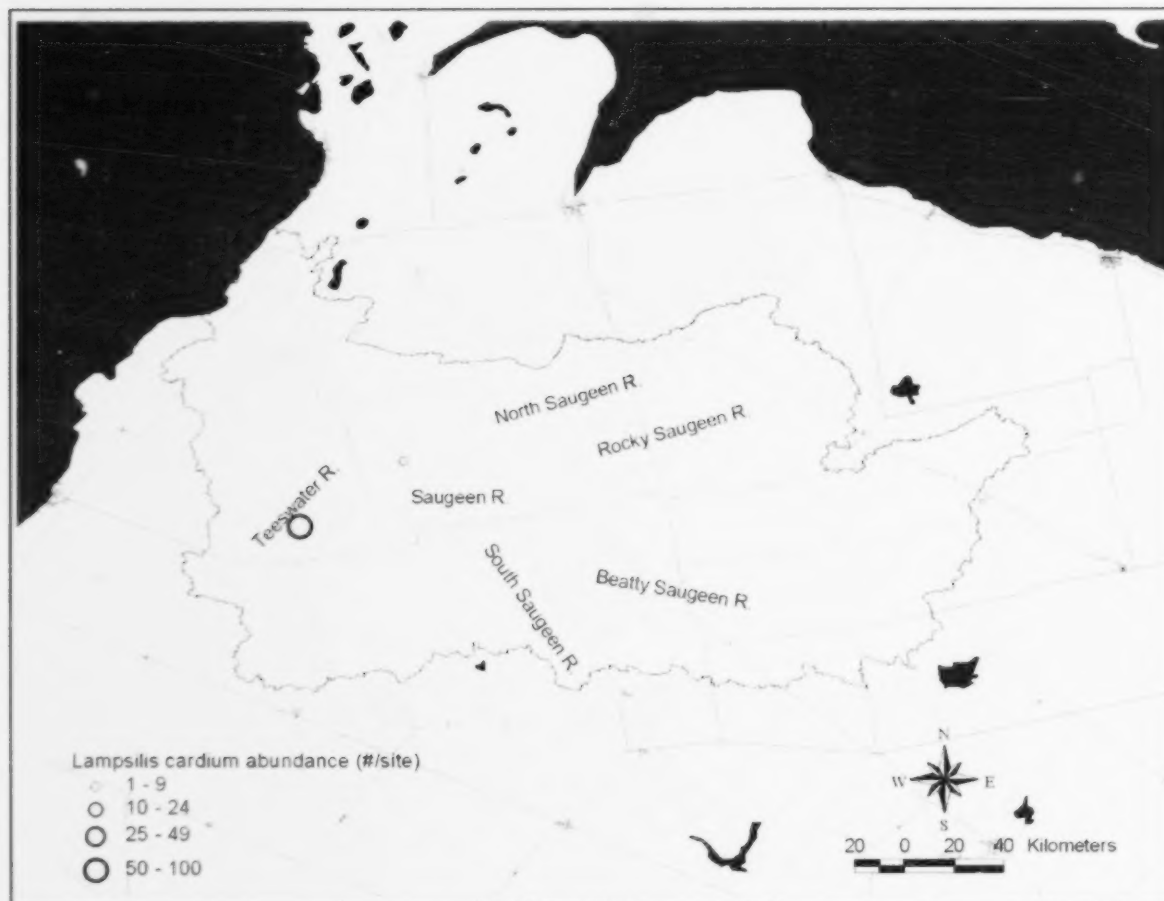


Figure 11. Total abundance and distribution of *Lampsilis cardium* collected during 2006.



Figure 11. Total abundance and distribution of *Lampsilis cardium* collected during 2006.

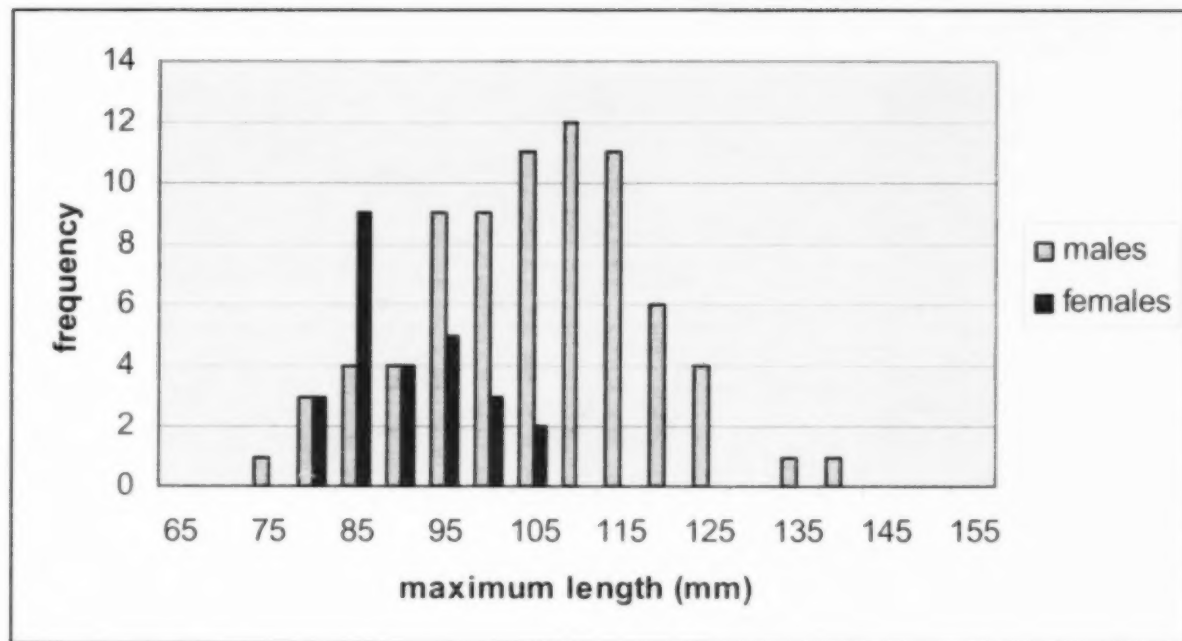


Figure 12. Length frequency distribution for the 76 male *L. cardium* and 26 female *L. cardium* collected in 2006.

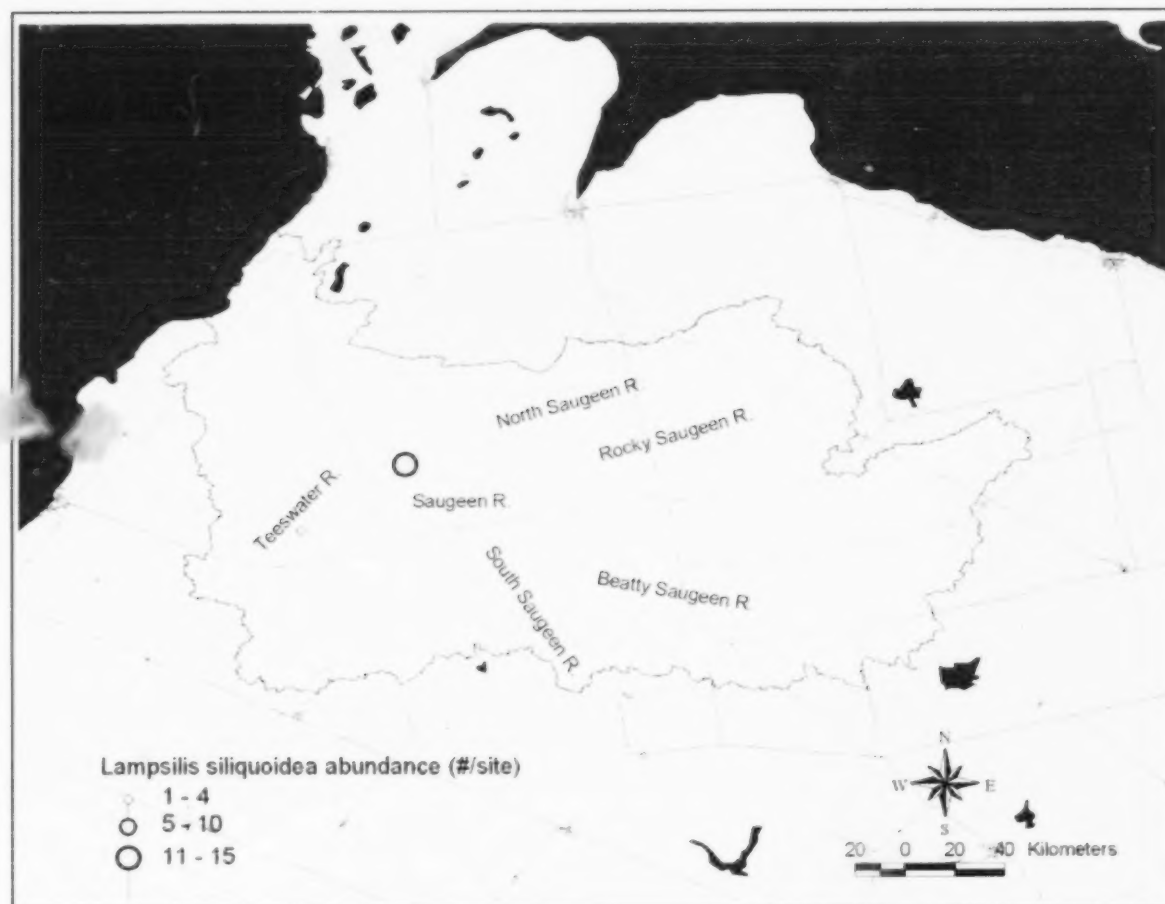


Figure 13. Total abundance and distribution of *Lampsilis siliquoidea* collected during 2006.

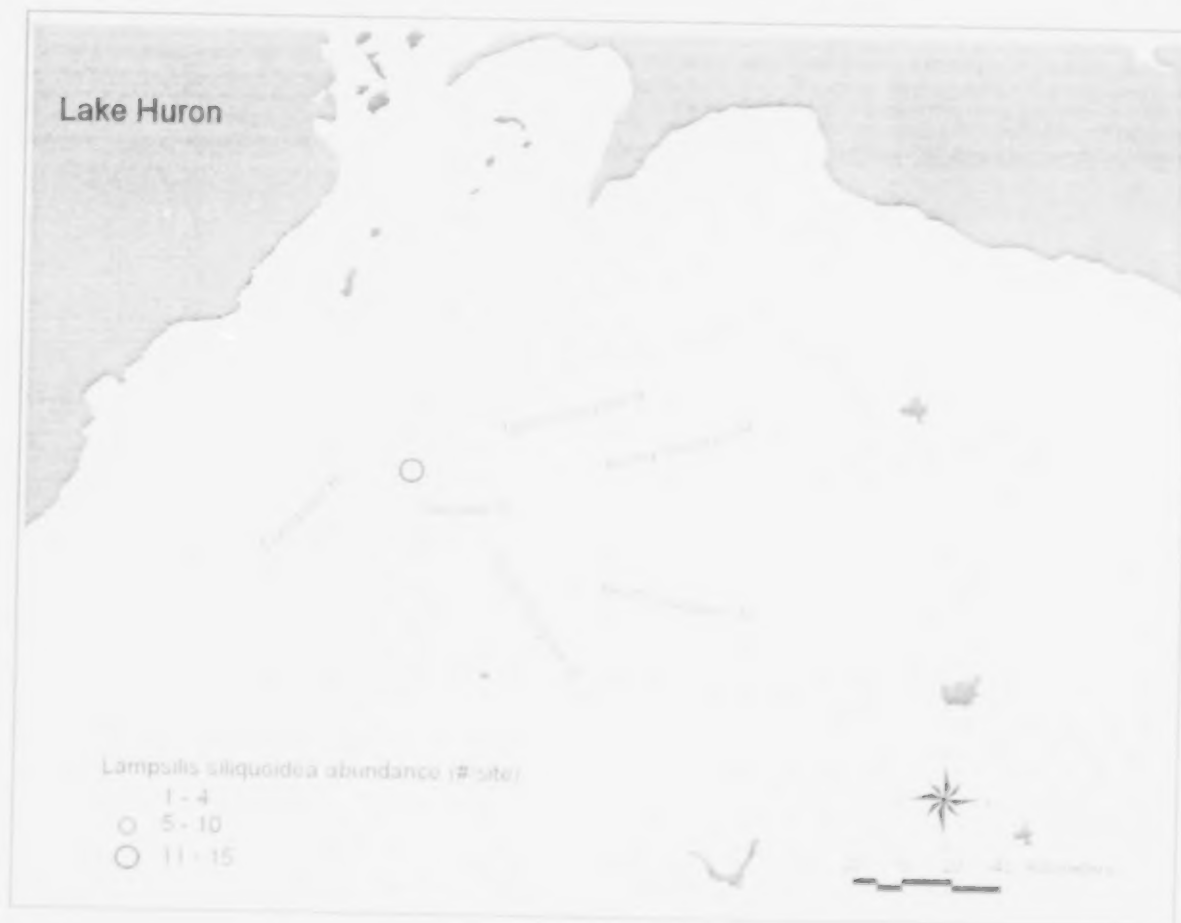


Figure 13. Total abundance and distribution of *Lampsilis siliquoides* collected during 2000.

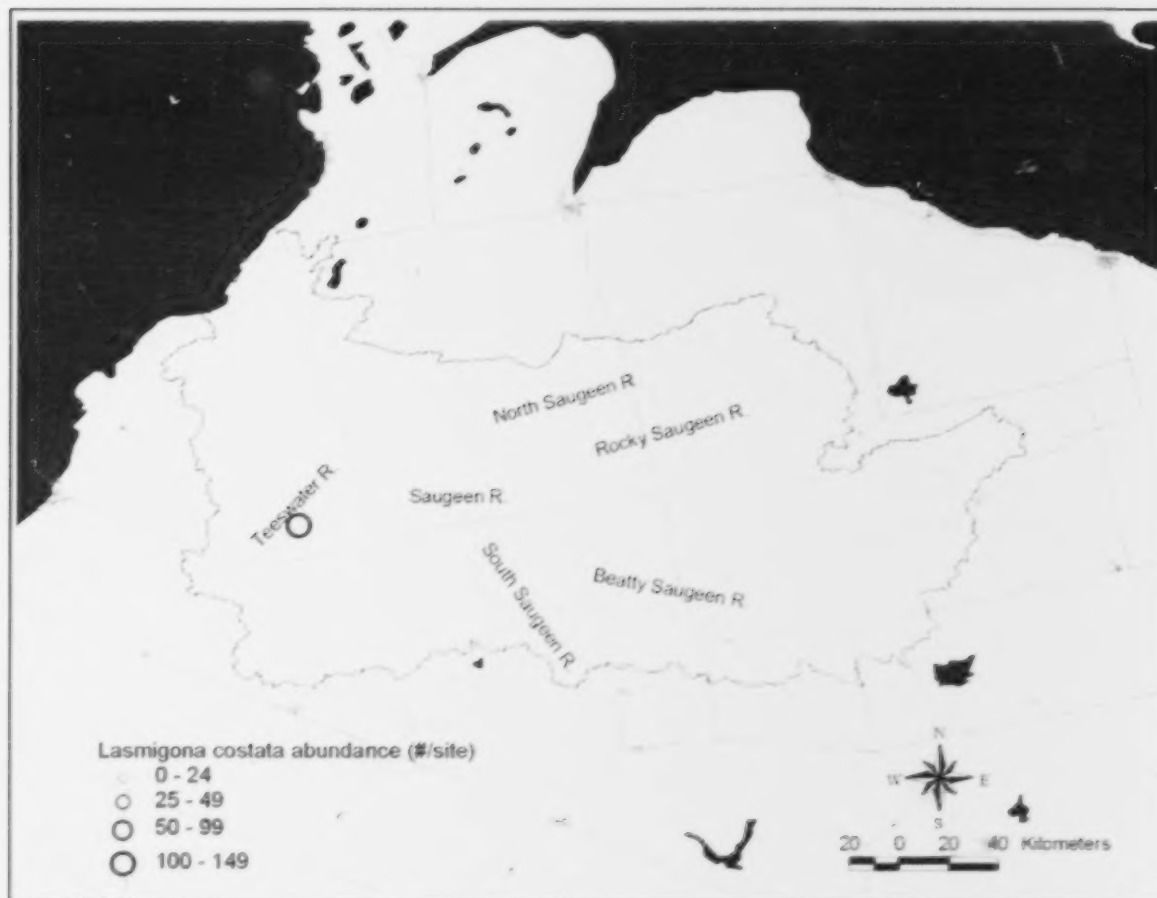


Figure 14. Total abundance and distribution of *Lasmigona costata* collected during 2006.



Figure 14 Total abundance and distribution of *Lasmigona costata* collected during 2006.

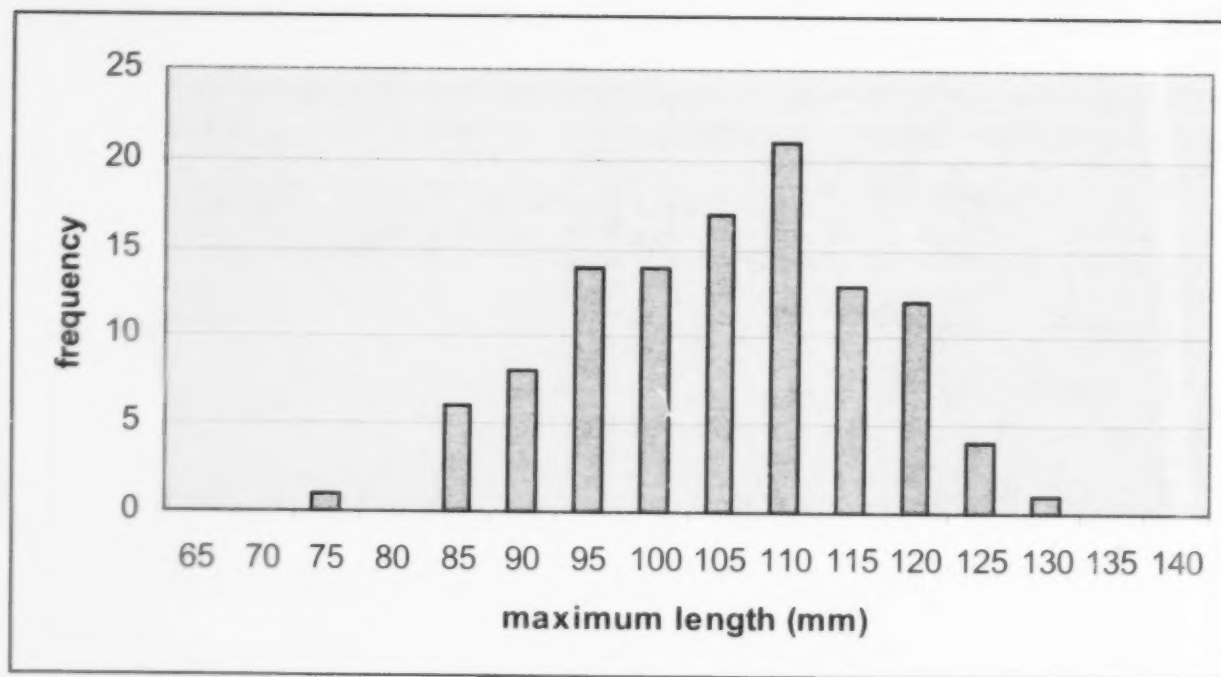


Figure 15. Length frequency distribution for the 111 *L. costata* collected in 2006.

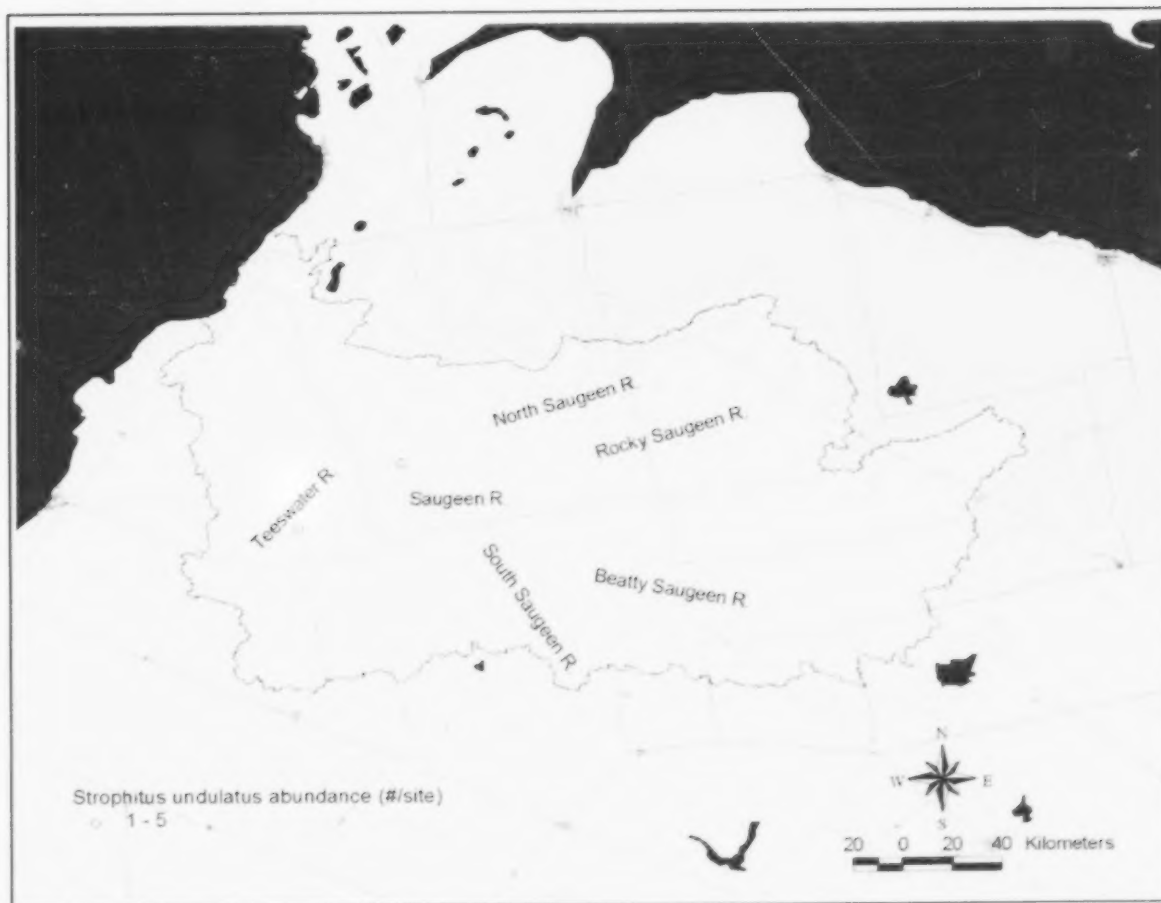


Figure 16. Total abundance and distribution of *Strophitus undulatus* collected during 2006.



Figure 16. Total abundance and distribution of *Strophitus undulatus* collected during 2006.

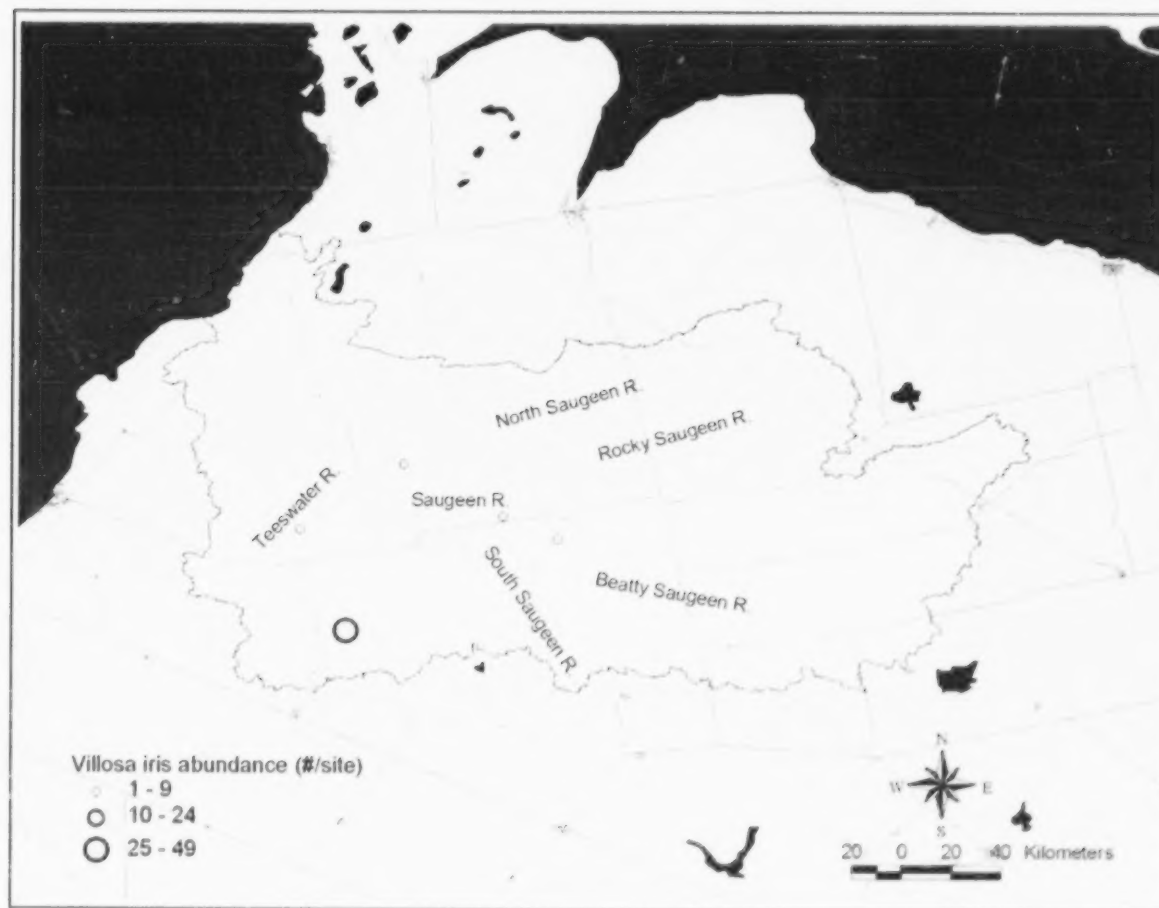


Figure 17. Total abundance and distribution of *Villosa iris* collected during 2006.



Figure 17. Total catch rates and distribution of white perch (2000)

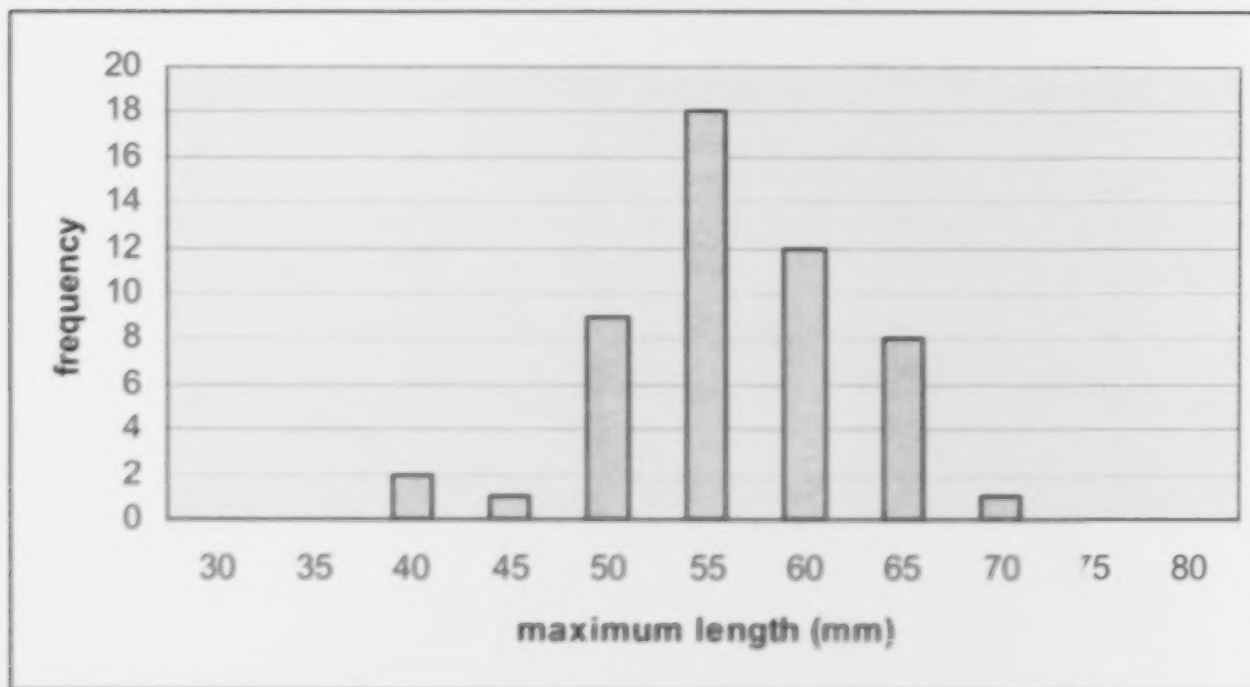


Figure 18. Length frequency distribution for the 51 *V. iris* collected in 2006.

